POWER TRANSMISSION SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention. The present invention relates to a power transmission system and, more particularly, to a system wherein input and output pawls are utilized to be driven by an input drive ring and drive an output drive ring through a plurality of different torque transmission ratios.

2. Description of the Prior Art. A variety of variable transmission systems having pulleys with varying diameters are known such as those shown in U.S. Patent No. 1,626,701 (Sleeper) and U.S. Patent No. 1,279,271 (Sockl). These devices contain variable pulleys associated with belt drive power transmission systems. Another type of system is shown in U.S. Patent No. 4,697,469 and U.S. Patent 5,545,766 which both disclose pinned ratchet pawls with a floating ring gear. Another type of system is shown in U.S. Patent No. 3,956,944 which discloses a variable ratio chain sprocket where a plurality of chain engaging segments are slidably affixed first between a pair of discs and are constrained to move in a radial direction with respect thereto. There are, however, variables in these types of construction that make it difficult to manufacture and to precisely adjust the transmission and to avoid excessive

wear. More recently, a system shown in U.S. Patent No. 5,971,877 covers a variable transmission system utilizing in one embodiment a shifter device with a stationary driver ring, a moveable drive body, and an appropriate control mechanism for selectively displacing the drive body with respect to the driver ring and sprocket while this patented device reflects a relatively new approach to variable speed transmission systems, there is a limitation with respect to the range and strength within which the torque transmission ratio can vary.

Thus, there is need to provide an even more efficient and greater variation in the torque transmission ratio range of such transmission system. It is to this need that the present application is directed.

SUMMARY AND OBJECTIVES OF THE INVENTION

The present invention is a new and improved power transmission system for bicycles and other vehicles utilizing a standard fixed axle and rotating chain sprocket engaging an endless chain that receives and input torque and transmits an output torque. The system includes a transmission ratio varying apparatus having a drive collar secured to the sprocket and at least one input drive ring and one output drive ring. A drive body is displaceable with respect to the input and output drive rings, and input

and output pawls are pivotally connected to the drive body and engageable with the input and output drive ring. A series of shifter housings are moveable with respect to the fixed axle to rotatably shift the drive body with respect to the drive ring and change the relationship between the input and output pawls. Movement of the shifter housings to change the relationship between the input and output pawls, done inversely with respect to each other, changes the torque transmission ratio. The system is highly flexible and expandable to encompass a broad range of torque transmission ratios.

From the summary set forth above, it can be seen that a primary objective of the present invention is to provide a new and improved power transmission system for bicycles and other vehicles which has all of the advantages of prior art assemblies and none of the disadvantages.

It is another objective of the present invention to provide a new and improved power transmission system of the type described which utilizes input and output pawls that experience a changing relationship with each other to be driven by the input drive ring and drive the output drive ring and thereby vary the torque transmission ratio accordingly.

Yet still another objective of the present invention is to provide a new and improved power transmission system of

the type described which is capable of being retrofitted to existing rear axles of the majority of standard size bicycles.

Thus, there ahs been outlined the more important features of the invention in order that the detailed description that follows may be better understood and in order that the present contribution to the art may be better appreciated. There are, of course, addition features of the invention that will be described hereinafter and which will form the subject matter of the claims appended hereto. In this respect, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways.

It is also to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting. Those skilled in the art will appreciate that the concept upon which this disclosure is based may be readily utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including equivalent constructions insofar as

they do not depart from the spirit and scope of the present invention.

Thus the enumerated objectives and others identified hereinafter, along with the various features of novelty which characterize the invention, are pointed out with particularity in the claims annexed hereto and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and the specific objectives attained by its use, reference is made to the accompanying drawings forming a part of the specification in which like characters of reference designate like parts throughout the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side elevational, sectional and schematic view of the power transmission system comprising the present invention showing the operating cable secured to the shifter collar, the input and output drive rings, and the fixed axle supported by the drop out fork of the wheel support mechanism when the torque transmission ratio of the power transmission system is set at 1:1;

Fig. 2 is a side elevational, fragmented, enlarged and schematic view of the operating lever and the shifter collar connected by the cable and the endless chain operably

connected to the sprocket when the torque transmission ratio of the power transmission is set at 1:1;

Fig. 3 is a side elevational, sectional and schematic view of the hub, the input drive ring, the front shifter housing, the axle cam, the drive body and the input and output pawls when the torque transmission ratio of the power transmission system is set at 1:1;

Fig. 4 is the power transmission system shown in Fig. 1 when the torque transmission ratio is 1:4.3;

Fig. 5 is the power transmission shown in Fig. 2 when the torque transmission ratio is 1:4.3; and

Fig. 6 is the power transmission shown in Fig. 3 when the torque transmission ratio is 1:4.3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention utilizes a series of gear trains that are added together to obtain a desired ratio range for the transmission. While any number of gear trains may be used, an example incorporating four gear trains within the hub will be depicted herein and described in detail in this specification. It is to be understood that the invention can employ any number of gear trains added together to increase the ratio range as desired.

Referring now to the drawings and particularly to Fig. 1, a cog 10 of a sprocket 12 is fixedly secured to a drive

collar 14. Drive collar 14 contains a first drive ring 16 including an array of teeth on the inside diameter which drives input pawl 18 (Fig. 3) as shown. Input pawl 18 drives a drive body 42 which, in turn, drives an output pawl 22 which in turn drives an output drive ring 24. Input and output drive rings 16, 24, together with their associated pawls 18, 22 provides the first of a series of gear trains which continue until output drive ring 24 is rigidly secured in hub 26.

To describe the apparatus more particularly, a gear train consists of an input drive ring 16, drive input pawl 18, which drives output pawl 22 which drives output drive ring 24. Output drive ring 24 is fixedly secured to the next input drive ring 28 through a rigid connection 30 which drives the next train. The series of trains continues until the output drive ring is secured in hub 26. As the series of trains are added, the overall ratio of the transmission is building exponentially. For example, if one train is capable of generating 145% of range, then four trains can generate 125% to the fourth power (145^4).

Shifting the transmission system is done by positioning a rotating handle 32 which moves a cable 34 that is secured to the shifter collar 36. Axle cams 40a,b,c are rigidly and eccentrically fixed, 180 degrees apart from each other in series, to the axle. Only when shifting the transmission to

another ratio, shifter collar 36, when displaced by handle rotor 32 and cable 34, rotates the series of shifter housings 38a,38b together in unison with the shifter housing bridges 99a,99b so that the front shifter housing 38a rotates about front axle cam 40a which then, via the front shifter housing bridge 99a, rotates the shifter middle housing 38b about the middle axle cam 40b which is eccentrically located 180 degrees apart from the front shifter housing 38a, which then in turn rotates the back shifter housing 38c, via the back shifter housing bridge 99b, about the back axle cam 40c which is eccentrically located 180 degrees apart from the middle shifter housing 38b. The series of drive bodies 20 are mounted with bearings 44 on the outside diameter of series of shifter housings 38a,b,c. When shifter housings 38a,b,c are rotated, drive bodies 42 with pawls 18, 22 are offset as well. This change in radius that drive bodies 42 and pawls 18, 22 have relative to input and output drive rings 16, 24 causes the angular velocity of output drive rings 24 to be greater than that of input drive rings 16. The greater the offset of shifter housing 38, drive body 42, and pawls 18, 22, the greater the range of the transmission ratio. Due to the 180 degree opposing offset of the series of shifter housings and axle cams, the transmission is able to withstand larger loads during the eccentric shift which in

turn allow the transmission to be shifted to a greater eccentric offset; thus, producing larger ratios with respect to size and weight.

The power transmission system comprising the present invention is extremely efficient and, depending upon the number of trains, minimizes wear on the components of the system. The number of trains capable of being used is from a minimum of one to an infinite number.

The power transmission system comprising the present invention has been illustrated and described in operable form. It is to be realized that optimum dimensional relationships for the parts of the invention to include variations in size, materials, shape, form, function and manner of operation, assembly and use are deemed readily apparent and obvious to one skilled in the art. All equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed herein. The foregoing is considered as illustrative only of the principles of the invention. Numerous modifications and changes will readily occur to those skilled in the art, and it is not desired to limit the invention to the exact construction and operation shown and described. All suitable modifications and equivalents that fall within the scope of the appended claims are deemed within the present inventive concept.